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Environ

Sessional Paper No. 317  
1st Session 32nd Parliament  
Tabled Thursday, 17 December 1981  
*John Hamer Clerk*

*1979-1980  
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# **EXPANSION OF THE URANIUM MINES IN THE ELLIOT LAKE AREA**

**Response  
of The Government of Ontario  
to the final report of the  
Environmental Assessment Board  
on the expansion of the  
uranium mines in Elliot Lake**

## **PART II: MINING, MILLING, TAILINGS MANAGEMENT AND RADIOACTIVITY**

**December, 1981**



**Ontario**

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RESPONSE  
OF THE GOVERNMENT OF ONTARIO  
TO THE FINAL REPORT OF THE  
ENVIRONMENTAL ASSESSMENT BOARD  
ON THE EXPANSION OF THE  
URANIUM MINES IN ELLIOT LAKE

PART II:  
MINING, MILLING, TAILINGS MANAGEMENT  
AND RADIOACTIVITY

DECEMBER 1981

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## INTRODUCTION

This report is the second part of the Government of Ontario's response to the final report of the Environmental Assessment Board titled "The Expansion of the Uranium Mines in the Elliot Lake Area." The Board's report was published in May, 1979 following which the Minister of the Environment requested a comprehensive review be undertaken by provincial ministries involved with the expansion of the uranium mines. In November, 1979, the Government published its responses to the parts of the Board's report dealing with the effect of the mining expansion on community development in the Elliot Lake area. This report deals respectively with Mining, Milling, Tailings Management and Radioactivity.

The Government wishes to commend the Environmental Assessment Board on the manner in which the hearings were conducted and the comprehensiveness of the final report. The Government also acknowledges and appreciates the hard work of the parties and participants at the hearings. The companies brought forward an impressive group of experts, sometimes from far afield, to assist in explaining complex subjects. The representatives of the United Steel Workers of America also contributed significantly. The Serpent River Indian Band brought a special perspective to the hearings.

The management of the environment requires both an understanding of the impacts of development and a willingness on the part of those involved to deal with the problems wisely and in a spirit of co-operation. As a result of the hearings and the reports of the Environmental Assessment Board on the expansion of the mines at Elliot Lake, as well as the views of the Select Committee on Ontario Hydro Affairs, the Ontario Government is better informed and has a better perspective on the priorities for further action. The next step will be to urge the implementation of the priorities in close consultation with the parties involved.

A major obstacle to achieving the priorities is that the control and regulation of mining operations at Elliot Lake is made difficult by the lack of a clear definition of responsibilities between the Federal and Provincial Governments.

The constitutional power of the Federal Government is such that very little of what is called for in this report can be achieved without the full co-operation of Federal Government agencies, particularly the Atomic Energy Control Board (AECB).

For the present, therefore, the Ontario Government acknowledges the role of the AECB as the prime authority for licencing the operation of the mines at Elliot Lake. It notes, however, that the AECB's definition of its operations has been too general in scope for specific actions of concern to the Ontario Government to be achieved. The Ontario Government is committed to clarifying the situation and has initiated discussions with the Federal Government on this matter.

Having recognized the importance of the AECB licence of operation as a potential tool in the development and maintenance of an environment management program for Elliot Lake, the Ontario Government is encouraged that the AECB has agreed to include provincial priorities and objectives of importance in AECB licenses. There are numerous references in the Government's response to matters where joint federal and provincial action is required which should be included in the AECB's operating licences.

In its final report the Environmental Assessment Board expressed the opinion that the technology exists for the expansion of the mines to proceed in an environmentally acceptable manner in the short term. In the long term, the Board concluded that further research was necessary by all concerned to deal with such important subjects as the management of tailings and the improvement of water quality in the Serpent River system.

The Government is encouraged by the Board's objective assessment and reaffirms the Government's concern for, and commitment to, the protection of the environment in the Elliot Lake area along with the expansion of the mining operations. To fulfill this commitment, the Government intends to initiate a comprehensive management program for the environment in Elliot Lake involving all of the parties. This program will include the appointment of a co-ordinating committee to assist in clarifying functions and roles, overseeing research projects and expediting review procedures. The program will also include the maintenance and, in some cases, enhancement, of the already extensive monitoring roles of the Ministries of the Environment, Labour and Natural Resources. The Government is supportive of the expansion, but will ensure that the expansion, operation and decommissioning of the mining operations comply with the appropriate legislation, regulations, objectives and criteria. In this context the Government perceives the companies as being responsible for carrying out their activities within the framework of the required environmental objectives.

The Government agrees with the Board that timely information should be made available for use by the public. The Ministry of the Environment will prepare annual reports on

the air and water monitoring programs being conducted in the Elliot Lake area. These reports will be available to the public.

Further in this regard, the Select Committee on Ontario Hydro Affairs recommended the establishment of a committee composed of members of the public in the Elliot Lake area. The Ministry of the Environment has implemented this recommendation.

In addition, the Government is committed to a review after five years of tailings management techniques. Recommendations on the scope and nature of the review will be a responsibility of the co-ordinating committee.

For Elliot Lake, the Government's immediate priorities are as follows:

- to initiate steps aimed at developing a rehabilitation strategy for the Serpent River system including the necessary reduction of ammonia in the effluents from the mining/milling operations
- to reduce the quantity of fresh water used in the mines and mills
- to participate in the development and implementation of a long term tailings management strategy for Elliot Lake in consultation with the mining companies and Federal Government agencies. This will include the investigation into the establishment of an appropriate fund or funds to guarantee the stability and long term maintenance of tailings areas.
- to establish an adequate data base for determining ambient air quality in relation to existing and proposed developments
- within its jurisdiction, the Government of Ontario will ensure that no significant risk to the health of the public results from either the naturally-occurring or technologically-enhanced components of radioactivity.

A further consideration is that the general approach in Elliot Lake should easily be applicable to other uranium producing areas in Ontario, such as Bancroft.

The sections that follow list the Ontario Government's responses to the findings and recommendations of the Environmental Assessment Board. For the most part, the responses are in the same sequence as presented in the Board's final report except those sections dealing with the tailings management and water quality where the substance of the responses made it necessary for the

sequence to be changed. The final section of the report deals with general considerations not included specifically in the findings or recommendations.

# 1. MINING

This section includes responses to the following:

- Testing waste rock
- Mine water treatment
- Recycling mine water
- Handling of explosives
- Backfilling as a mining technique

## Testing Waste Rock (Chapter 8-1 and 8-2)

- 8-1 THE BOARD RECOMMENDS THAT THE COMPANIES MAINTAIN A PROGRAM OF TESTING WASTE ROCK HAULED FROM THE MINE OR EXCAVATED IN ANY WAY ON MINING COMPANY PROPERTY FOR PYRITE CONTENT, AND IF IT IS A NET ACID PRODUCER THE WASTE ROCK SHOULD BE STORED IN AN AREA APPROVED FOR TAILINGS STORAGE.
- 8-2 THE BOARD RECOMMENDS THAT THE COMPANIES MAINTAIN A PROGRAM OF TESTING WASTE ROCK HAULED FROM THE MINE OR EXCAVATED ON MINING COMPANY PROPERTY AND ANY ROCK DEMONSTRATING ANY RADIONUCLIDE POTENTIAL AND NOT SUITABLE FOR USE IN THE MILL, BE PLACED IN AN AREA APPROVED FOR TAILINGS STORAGE.

The testing of waste rock for acid generation potential and radionuclide potential is being carried out by the companies pursuant to the operating licence issued by the AECB.

All sulphur minerals including pyrite are assayed in the acid generation potential test.

## Mine Water Treatment (Chapter 8-3 and 8-4)

- 8-3 THE BOARD FINDS THE CONVERSION OF THE DENISON MINE WATER TREATMENT SYSTEM FROM AMMONIA NEUTRALIZATION UNDERGROUND TO ABOVE GROUND LIME TREATMENT TO BE COMMENDABLE AS AN ENVIRONMENTAL PROTECTION MEASURE.
- 8-4 THE BOARD RECOMMENDS THAT THE MINING COMPANIES SHOULD DISCONTINUE IMMEDIATELY THE PRACTICE OF USING AMMONIA FOR NEUTRALIZATION PURPOSES.

The Government agrees that the neutralization of mine water above ground and its treatment by lime rather than by ammonia is an important objective for both of the mining companies and notes the companies have initiated such a process.

Recycling Mine Water (Chapter 8-5 to 8-7)

- 8-5 THE BOARD FINDS THAT PRELIMINARY TESTS ON TAILINGS DECANT WATER CARRIED OUT BY THE MINISTRY OF LABOUR TO DETERMINE THE SILICA LEVELS GIVE RISE TO SERIOUS CONCERN AS TO THE USE OF SUCH WATER UNDERGROUND.
- 8-6 THE BOARD FINDS THAT WITH THE HIGH TOTAL DISSOLVED SOLIDS LEVELS EXPECTED IN TAILINGS DECANT WATER AND IN MINE WATER, SHOULD THIS WATER BE RECYCLED TO THE MINES, SERIOUS PROBLEMS OF SCALING COULD OCCUR IN EQUIPMENT AND PIPES NECESSARY TO THE SAFE AND EFFICIENT OPERATION OF THE MINES.
- 8-7 THE BOARD RECOMMENDS THAT NO USE OF RECYCLED WATER UNDERGROUND OCCUR AT THE PRESENT TIME.

The possibility of recycling mine water for re-use underground was suggested by the government in its July, 1978 response to the Environmental Assessment Reports as a means of reducing the amount of fresh water being used. The Government concurs with the findings and recommendations of the Board that the companies do not use recycled water underground at the present time.

Handling Explosives (Chapter 8-8 to 8-15)

- 8-8 THE BOARD FINDS THAT THE MISFIRE RATE IN THE RIO ALGOM MINE IS EXCESSIVE.
- 8-9 THE BOARD RECOMMENDS THAT BOTH MINING COMPANIES IMPLEMENT MEASURES TO REDUCE THEIR MISFIRE RATE.
- 8-10 THE BOARD RECOMMENDS CONTINUATION AND ENHANCEMENT OF THE COMPANIES' EDUCATIONAL PROGRAMS RELATING TO THE USE AND HANDLING OF EXPLOSIVES. THESE PROGRAMS SHOULD STRESS THE CARE REQUIRED IN THE HANDLING AND LOADING OF THE EXPLOSIVE ANFO IN ORDER TO MINIMIZE SPILLAGE AND WASTAGE.
- 8-11 THE BOARD FINDS THAT A NEED FOR THE 'EXPLOSIVES HANDLING MANUAL' REQUESTED IN THE MAY 10, 1977 RULING BY THE ENVIRONMENTAL ASSESSMENT BOARD HAS BEEN DEMONSTRATED IN THE HEARING. THIS MANUAL SHOULD IDENTIFY PRACTICES AND PROCEDURES TO AVOID OR MINIMIZE EXPLOSIVE LOSSES.
- 8-12 THE BOARD RECOMMENDS THAT THE COMPANIES DEVELOP CONTROL SYSTEMS OR INCENTIVE PROGRAMS TO MINIMIZE THE LOSS OF EXPLOSIVE NOT USED IN LOADING OF THE CHARGE.
- 8-13 THE BOARD RECOMMENDS THAT BOTH COMPANIES UTILIZE THE BULK DELIVERY SYSTEM FOR ANFO WHEREVER MINING

METHODS PERMIT THE ACCESS OF THE REQUIRED EQUIPMENT.

- 8-14 THE BOARD RECOMMENDS THAT WHERE THE USE OF A BULK DELIVERY SYSTEM IS NOT POSSIBLE A PALLETIZED SYSTEM OF BAG DELIVERY BE USED TO BRING THE EXPLOSIVE AS CLOSE TO THE WORKING FACE AS POSSIBLE, SAFETY CONSIDERATIONS BEING TAKEN INTO ACCOUNT.
- 8-15 THE BOARD RECOMMENDS THAT THE PROVINCE REQUIRE THE COMPANIES TO REDUCE EXPLOSIVE LOSSES AND THAT THE MINISTRY OF LABOUR MONITOR AND EVALUATE THE MEASURES TAKEN BY THE COMPANIES TO ACHIEVE THIS.

The Government believes the priority for handling explosives in the mines must be, first, the safety and health of workers, and second, the adoption of sound mining practices to reduce the adverse environmental consequences of spillage and wastage of ammonium nitrate explosives.

The handling of explosives is a major auditing item for mines inspectors of the Ministry of Labour. The proper use of explosives by the companies is controlled through regulations adopted pursuant to The Occupational Health and Safety Act, 1978, The Explosives Act, 1978 and the Ammonium Nitrate and Fuel Order (PC 1957-335). The Government is satisfied that these regulations are adequate and will ensure proper enforcement.

The improvement of mining practices involving explosives should be a matter of continuing review and discussion between the mining companies and their employees in the context of staff training programs. In this regard, it is noted the storage and handling of explosives is part of the Common Core curriculum of Basic Underground Hard Rock Mining Skills developed by the Ministry of Colleges and Universities.

The Ministry of the Environment will monitor and audit ammonia and nitrates in mine drainage water.

Backfill as a Mining Technique (Chapter 8-16 to 8-20)

- 8-16 THE BOARD FINDS THAT DENISON'S PROPOSED BACKFILLING PROGRAM WILL PROVIDE IMPORTANT INFORMATION ON THE USE OF BACKFILL TO RECOVER ORE. RESULTS, HOWEVER, WILL NOT BE AVAILABLE FOR TWO OR THREE YEARS AND THE PROGRAM IS NOT DESIGNED TO EXAMINE BACKFILLING AS A WASTE MANAGEMENT TECHNIQUE.
- 8-17 THE BOARD RECOMMENDS THAT DENISON CONSIDER CAREFULLY THE PARAMETERS TO BE MONITORED IN THEIR



BACKFILLING PROGRAM AND INCLUDE ANY ADDITIONAL PARAMETERS THAT COULD BE USED IN DETERMINING THE ADVANTAGES OR DISADVANTAGES OF BACKFILLING AS A WASTE MANAGEMENT OPTION. THE CONSIDERATIONS SHOULD INCLUDE GENERATION OF AIR OR WATER BORNE CONTAMINANTS, UNDERGROUND OR SURFACE DISPOSAL OF SLIMES AND A FULL COST BENEFIT ANALYSIS.

- 8-18 THE BOARD RECOMMENDS THAT RIO ALGOM LIMITED SHOULD COMMENCE STUDIES ON BACKFILLING AS A METHOD OF ORE RECOVERY AND WASTE DISPOSAL. SUCH STUDIES SHOULD INCLUDE THE ECONOMIC, OPERATIONAL AND ENVIRONMENTAL ASPECTS OF THE PROGRAM.
- 8-19 THE BOARD RECOMMENDS THAT BOTH RIO ALGOM LIMITED AND DENISON MINES LIMITED EVALUATE THE ORE RESERVES REMAINING IN THE FOOT WALL, HANGING WALL AND PILLARS AND DETERMINE WHAT WOULD JUSTIFY THE MINING OF THESE AREAS AS COMPARED TO OPENING NEW AREAS OF UNDERGROUND OPERATIONS IN LOWER GRADES OF ORE. THE RESULTS OF SUCH STUDIES SHOULD BE AVAILABLE FOR FUTURE DISCUSSIONS OF WASTE MANAGEMENT OPTIONS WITH REGULATORY AGENCIES.
- 8-20 THE BOARD RECOMMENDS THAT THE COMPANIES STUDY WHEN BACKFILLING OPERATIONS SHOULD COMMENCE IF BACKFILL IS TO BE USED TO ENABLE THE EXTRACTION OF THE ORE FROM THE FOOT WALL, HANGING WALL AND PILLARS. SUCH STUDIES SHOULD BE AVAILABLE FOR FUTURE DISCUSSIONS OF WASTE MANAGEMENT OPTIONS WITH THE REGULATORY AGENCIES.

At the hearings, backfilling was discussed both as a means of recovering ore and as a means of tailings management. The former aspect only is addressed in this section.

The Government agrees that the experimental program initiated by Denison Mines for the use of tailings as backfill should be pursued. The Ministry of Labour will be reviewing the program. However, the Government does not consider that the Rio Algom properties lend themselves to backfill as a method of pillar ore recovery and no useful purpose would be served by commencing studies on backfill for these ore bodies at this time.

## 2. MILLING

This section includes responses to the following:

- Conversion of mills
- Fresh water use in the mill
- Radium removal in the mill
- Thorium removal in the mill

Conversion of Mills (Chapter 9-1 to 9-6)

- 9-1 THE BOARD FINDS THAT THERE ARE A NUMBER OF MILLING PROCESS ALTERNATIVES WHICH COULD BE USED IN THE EXISTING OPERATING MILLS TO ELIMINATE DISCHARGES OF AMMONIA.
- 9-2 THE BOARD FINDS THAT THE ENVIRONMENTAL BENEFITS OF CONVERSION TO MAGNESIA FROM AMMONIA AS A PRECIPITATING AGENT PROVIDE A SIGNIFICANT REASON FOR SUCH CONVERSION IN ALL OPERATING OR PLANNED MILLS.
- 9-3 THE BOARD RECOMMENDS AN IMMEDIATE COVERSION OF THE OPERATING MILLS OF RIO ALGOM LIMITED (QUIRKE MILL) AND DENISON MINES LIMITED (DENISON MILL) TO THE NITRATE ELUTION MAGNESIA PRECIPITATION (NEMP) PROCESS.
- 9-4 THE BOARD FINDS THE DEVELOPMENT OF THE LIMESTONE ACID MAGNESIA ION EXCHANGE (LAMIX) PROCESS BY RIO ALGOM LIMITED AND ITS PROPOSAL TO USE THIS PROCESS AT RIO'S PANEL MILL TO BE HIGHLY COMMENDABLE.
- 9-5 THE BOARD RECOMMENDS THAT WITHIN TWO YEARS OF THE START-UP OF THE LAMIX PROCESS IN THE PANEL MILL THERE SHOULD BE MADE AVAILABLE TO THE MINISTRY OF THE ENVIRONMENT BY RIO ALGOM LIMITED A DETAILED EVALUATION OF THE PROCESS FLOWS AND THE CHEMICAL CONCENTRATIONS IN THE FLOWS.
- 9-6 THE BOARD RECOMMENDS THAT THE DEVELOPMENT AND USE OF THE LAMIX PROCESS AT THE PANEL MILL BE MONITORED CLOSELY BY PROVINCIAL AND FEDERAL AGENCIES. UPON COMPLETION OF ITS DEVELOPMENT, AND IF OTHER PROCESSES CANNOT MEET THE EFFLUENT LIMITS OF LAMIX FOR TDS AND FLOWS, LAMIX SHOULD BE APPLIED TO ANY OTHER NEW OR REHABILITATED MILLS COMMENCING OPERATION IN THE ELLIOT LAKE AREA IN THE FUTURE.

The objective is to ensure that the quantity of ammonia in mill effluents is reduced in order to permit the establishment of viable and self-sustaining fishery in the Serpent River System. To achieve this end, rather than recommending the adoption of a specific process, the AECB has indicated willingness to include in the operating licences objectives for the discharge of ammonia. It will be the responsibility of the companies to seek and to implement solutions to achieve these objectives.

The Government is encouraged that Rio Algom has installed the LAMIX process at the Panel Mill. It considers important the continued evaluation of the process and, as recommended by the Board, is monitoring its phasing-in and use to determine whether effluents meet objectives.



In this regard, the Government will impress on the AECEB the need in the operating licence to include a report twice yearly on the implementation of the process, including effluent loadings and flows.

Fresh Water Use in the Mill (Chapter 9-7 to 9-10)

- 9-7 THE BOARD FINDS THAT WATER CONSUMPTION IN BOTH DENISON AND RIO MILLS COULD BE REDUCED TO, AT MOST, 23 l/s PER 1000 METRIC TONS PER DAY AND EVEN LESS IF SPECIFIC ATTENTION WAS PAID TO REDUCING WATER USAGE.
- 9-8 THE BOARD FINDS THAT IT IS NOT NECESSARY TO USE FRESH WATER FOR REPULPING TAILINGS AND TAILINGS TRANSPORT.
- 9-9 THE BOARD RECOMMENDS THAT RIO ALGOM AND DENISON USE ONLY RECEIVED WATER, OR OTHER USED MILL WATER, FOR TAILINGS TRANSPORT.
- 9-10 THE BOARD IS SATISFIED THAT FURTHER ACTION CAN BE TAKEN TO MINIMIZE THE USE OF FRESH WATER IN THE MILLS AND RECOMMENDS THAT SUCH ACTION BE TAKEN.

The Ministry of the Environment will review each mill operation with the view of having the companies reduce the use of fresh water. The resulting requirements will be enforced through appropriate provisions in The Ontario Water Resources Act and through recommendations to the AECEB for incorporation in the operating licences.

Radium Removal in the Mill (Chapter 9-11 to 9-12)

- 9-11 THE BOARD FINDS THAT RADIUM REMOVAL IN THE MILL IS NOT PRACTICAL BASED ON PRESENT TECHNOLOGY.
- 9-12 THE BOARD RECOMMENDS THAT THE CANADA CENTRE FOR MINERAL AND ENERGY TECHNOLOGY (CANMET) CONTINUE STUDYING WAYS OF REMOVING RADIUM IN THE MILL WITH EMPHASIS ON PROCESSES THAT WILL HAVE MINIMAL IMPACT ON THE ENVIRONMENT.

The Government will monitor CANMET's program to study means of removing radium in the mill.

Thorium Removal in the Mill (Chapter 9-13 to 9-16)

- 9-13 THE BOARD FINDS THAT THERE IS SUITABLE MILLING TECHNOLOGY AVAILABLE FOR THE REMOVAL OF ABOUT 60% OF THE THORIUM FROM THE ORE.
- 9-14 THE BOARD FINDS ON THE EVIDENCE OF THE COMPANIES THAT THERE IS AT PRESENT ONLY A VERY LIMITED MARKET FOR THORIUM AND THAT NO SUBSTANTIAL CHANGE IS LIKELY FOR ONE OR TWO DECADES.

9-15 THE BOARD FINDS THAT IF THORIUM WERE REMOVED IT WOULD REQUIRE TREATMENT AND MANAGEMENT AS A LOW TO MEDIUM LEVEL WASTE, AND WOULD HAVE TO BE STORED IN A CONTROLLED AREA FOR AN INDETERMINATE PERIOD.

9-16 THE BOARD RECOMMENDS THAT THORIUM REMOVAL IN THE MILL SHOULD NOT BE REQUIRED OF THE MINING COMPANIES AT THIS TIME.

The Government agrees with the Board's findings and recommendations. Recognizing the potential value of thorium in the future and the desirability of reducing the quantity of radioactive material in the tailings, the Government recommends serious consideration be given to its removal in the mill should market conditions improve. The Ministry of Natural Resources will monitor developments in this aspect of the mineral market as part of its mineral resources program.

### 3. TAILINGS MANAGEMENT

Tailings management is a complex subject. Accordingly, the following section divides the findings and recommendations of the Environmental Assessment Board into the following groups:

1. Preparatory actions for a tailings management strategy (Chapters 10-30 to 10-41; 10-16 to 10-29)
2. Recommendations involving current tailings operations and tailings management programs:

- Tailings lines
- Bud Lake
- Radium precipitation
- Radium redissolution
- Tailings dams
- Stacking and coning

1. Preparatory Actions for a Tailings Management Strategy (Chapter 10-30 to 10-41 and 10-16 to 10-29)

10-30 THE BOARD FINDS THAT THE MILL TAILINGS HAVE THE GREATEST POTENTIAL IMPACT ON THE NATURAL ENVIRONMENT OF ALL THE ACTIVITIES RELATED TO THE MINES EXPANSION.

10-31 GIVEN PRESENT DAY KNOWLEDGE, THE BOARD FINDS THE FOLLOWING GOALS AND OBJECTIVES TO BE APPROPRIATE IN THE DEVELOPMENT AND THE OPERATIONAL AND POST-OPERATIONAL LIFE OF TAILINGS AREAS:

- a) MAXIMIZE CAPACITY,
  - b) MINIMIZE SURFACE DRAINAGE TO THE SITE,
  - c) MAXIMIZE USE OF NATURAL TOPOGRAPHY TO CONTAIN TAILINGS,
  - d) COLLECT, CONTROL AND TREAT ALL EFFLUENTS FROM OPERATING TAILINGS BASINS, AND FROM POST-OPERATIONAL TAILINGS BASINS AS LONG AS LEVELS OF CONTAMINANTS EXCEED FEDERAL AND PROVINCIAL STANDARDS OF CRITERIA,
  - e) DEVELOP SYSTEMS AND STRUCTURES TO MAXIMIZE WATER RETENTION (FOR TREATMENT) DURING OPERATION AND TO MINIMIZE WATER RETENTION WHILE STILL PERMITTING TREATMENT AFTER OPERATION CEASES,
  - f) ELIMINATE USE OF MECHANICAL MEANS (PUMPS, VALVES, FLOW REGULATORS, ETC.) TO CONTROL OR MOVE WATER IN TAILINGS AREAS IN THE POST-OPERATIONAL PERIOD, AND
  - g) MAXIMIZE RUNOFF FROM TAILINGS IN THE POST-OPERATIONAL PERIOD.
- 10-32 THE BOARD FINDS THAT THERE SHOULD BE SUFFICIENT CAPACITY IN THE EXISTING BASINS FOR WASTE THAT WILL BE GENERATED IN ONGOING EXPANSION, AS LONG AS THE COMPANIES CARRY OUT THE NECESSARY RESEARCH AND DEVELOPMENT AS OUTLINED IN THIS REPORT.
- 10-33 THE BOARD FINDS THAT CONTINUAL MAINTENANCE AND MONITORING OF THE POST-OPERATIONAL TAILINGS WILL BE REQUIRED UNTIL ABANDONMENT CAN BE PERMITTED BY THE APPROPRIATE FEDERAL AND PROVINCIAL AGENCIES. AT PRESENT, THE TIME TO ABANDONMENT AFTER MILL OPERATIONS CEASE IS NOT KNOWN.
- 10-34 THE BOARD RECOMMENDS THAT INTENSIVE STUDIES BE UNDERTAKEN BY THE MINING COMPANIES WITH THE ASSISTANCE OF CANMET INTO WAYS OF STABILIZING PYRITE IN THE TAILINGS.
- 10-35 THE BOARD FINDS THAT PYRITE REMOVAL IN THE MILL WOULD HAVE ADVANTAGES IF;
- a) ACID IS PRODUCED FOR USE IN THE MILLS OR,
  - b) IT IS NOT POSSIBLE TO DEVELOP A SELF-PERPETUATING AND HEALTHY VEGETATIVE COVER ON THE TAILINGS BECAUSE OF ACIDITY PROBLEMS.
- 10-36 THE BOARD RECOMMENDS THAT STUDIES OF WAYS OF HANDLING PYRITE REMOVED FROM TAILINGS BE IMMEDIATELY UNDERTAKEN BY THE COMPANIES. THESE STUDIES SHOULD EXAMINE BOTH ABOVE AND BELOW

GROUND STORAGE INCLUDING WAYS OF RENDERING THE PYRITE CONCENTRATE INERT.

- 10-37 THE BOARD RECOMMENDS THAT ALL RESEARCH PROGRAMS IN THE AREA OF WASTE MANAGEMENT BE REQUIRED TO PRODUCE RESULTS WITHIN THE NEXT THREE TO FIVE YEARS.
- 10-38 THE BOARD RECOMMENDS THAT NO NEW TAILINGS AREAS BE APPROVED AT LEAST UNTIL THE RESULTS OF RESEARCH PROJECTED FOR THE NEXT THREE TO FIVE YEARS CAN BE EVALUATED.
- 10-39 THE BOARD RECOMMENDS THAT THE PROVINCE AND THE AECB OVERSEE THE ESTABLISHMENT BY THE COMPANIES OF A LONG TERM WASTE MANAGEMENT STRATEGY. THE DEVELOPMENT OF THIS STRATEGY SHOULD BE COMPLETED WITHIN THE NEXT FIVE YEARS.
- 10-40 THE BOARD RECOMMENDS THAT IF A SATISFACTORY STRATEGY FOR THE MANAGEMENT OF TAILINGS BEYOND THE POST-OPERATIONAL PERIOD CANNOT BE DEVELOPED WITHIN FIVE YEARS A MECHANISM BE PUT IN PLACE BY THE RESPONSIBLE AUTHORITIES TO ENSURE THAT THERE WILL BE SUFFICIENT FUNDS AVAILABLE TO:
- a) UTILIZE THE BEST TECHNOLOGY AVAILABLE AS UNDERSTOOD AT THAT TIME,
  - b) MONITOR EFFLUENTS, FOR A PERIOD TO BE DETERMINED, AFTER OPERATIONS CEASE, AND
  - c) HAVE IN RESERVE FUNDS FOR FURTHER REMEDIAL WORK.
- 10-41 THE BOARD RECOMMENDS THAT IN FIVE YEARS THERE BE A PUBLIC HEARING INTO THE DEVELOPED WASTE MANAGEMENT TECHNIQUES AND IF NECESSARY THE FUNDING MECHANISM.

The Government agrees with the thrust of the Board's findings and recommendations on mill tailings and their impact on the environment. It therefore assumed the responsibility of initiating discussions with the Federal Government to initiate the development and implementation of a long term tailings management strategy for the Elliot Lake mining area. In developing the strategy with the Federal Government and the uranium mining companies the co-ordinating committee will be expected to take steps to ensure the following:

- the adoption of goals and objectives proposed by the Environmental Assessment Board as the basis of the planning and management of tailings in Elliot Lake area (Chapter 10-31);

- the establishment of priorities for research and monitoring among the various agencies involved;
- the development and implementation by the companies of comprehensive operational plans for the management of tailings areas;
- the investigation and establishment of an appropriate fund or funds to guarantee the stability and long term maintenance of tailings areas.

Recognizing the need for the co-ordination of research and its application to a long term program for the management of uranium tailings, in 1980 the Department of Energy, Mines and Resources proposed to Provincial Governments the establishment of a national program for the long term storage of uranium mine tailings. Discussions are currently underway.

In addition, the Ontario Government will impress on the mining companies the need for continued research at Elliot Lake into methods of storing tailings, preparatory actions for tailings abandonment, and the need to contribute to joint government-private sector research efforts.

With regard to the tailings storage (Recommendation 10-16 to 10-23), the Government concludes that stacking and coning are the most promising areas where significant advances appear to be possible in the short term. Further research is necessary by the two companies, the mining industry and government agencies before a clear order of priorities can be determined among solidification, underground storage and deep water disposal. The same applies to preparatory actions for tailings abandonment. The Government expects the companies, as major producers of uranium in Canada, to make a significant contribution to the research effort and to apply the results of their findings to such areas as radium redissolution, revegetation, pyrite oxidation, radium seepage and evapo-transpiration.

The Government does not agree with the Board's recommendation that priority be given to the study of backfilling over deep lake disposal as a waste management option. The known Elliot Lake ore bodies and the mining methods currently used for their extraction by the mining companies do not lend themselves to the underground storage of tailings during the operating life of the mines.

The underground storage of tailings, at this time, may limit future options. For example, the potential market conditions for thorium are not known and, as tailings

constitute a source of thorium, their underground placement may economically prohibit future extraction of this mineral resource. In the event that a market condition for thorium does develop, it could be extracted in the milling process and the potential exists for reworking surface tailings. In addition, the future ability of the companies to extract remaining uranium bearing deposits could be jeopardized by the initiation of a tailings storage program in existing mine openings.

Thus, at the request of the Ontario Government and the AECB, the companies are currently conducting a detailed examination of the possibility of utilizing Quirke Lake for tailings deposition.

As a result of these co-operative efforts, combined with the outcome of further research, the Government is confident that a long term waste management strategy can be evolved for the Elliot Lake area. In view of the long term nature of some research projects, it is doubtful whether a fully developed strategy can be assembled within the time recommended by the Board (Recommendation 10-39). The Government will ensure, however, that interim guidelines are established and put into effect within that period and that the activities of all the agencies involved will be co-ordinated and controls vigorously applied. Given the projected program of research into tailings management, the co-ordinated monitoring of activities by Provincial and Federal Agencies and the assertive application of controls, the Government will permit the expansion of new tailings areas (Recommendation 10-38) where the need can be demonstrated.

With regard to a proposed contingency fund (Recommendation 10-40), the Ontario Government agrees with the establishment of an appropriate fund or funds governing the management of tailings areas and that such funds be integrated with the development of a long term tailings management strategy. In developing that strategy further details should be gathered on the costs and means of various management and close-out techniques to ensure that the Government is afforded the opportunity to review alternative approaches and instruments. The Ontario Government will co-operate fully with the Federal Government in the formulation of the strategy and will impress on that government the need to include an appropriate fund or funds governing the management of uranium tailings.



As to a review by the public of tailings management techniques after five years (Recommendation 10-41), the Government will ensure that the opportunity is available for this to take place. Recommendations on the scope and nature of the review will be a responsibility of the co-ordinating committee.

In addition to the above and as a result of the recommendations of the Select Committee on Ontario Hydro Affairs, the Ministry of the Environment has initiated the establishment of a Public Information Committee. This committee is made up of representatives of various organized local groups, the mining companies and the regulatory agencies. The purpose of the committee is to exchange information including monitoring data, plans and special reports on an ongoing basis to ensure that local people are well informed about the mining operations in the Elliot Lake area.

Finally, the entire question of the management of tailings in the future is currently being discussed in the light of the AECB's "Draft Interim Close-Out Criteria". These criteria, if adopted, will have a significant impact on the strategies selected to manage uranium mine tailings.

- 10-16 THE BOARD FINDS THAT THE COMPANIES HAVE BEEN REMISS IN NOT STUDYING BACKFILLING AS A WASTE MANAGEMENT OPTION.
- 10-17 THE BOARD FINDS THAT DEEP WATER DISPOSAL HAS NOT RECEIVED SUFFICIENT STUDY TO DETERMINE WHETHER IT WOULD HAVE ANY BENEFICIAL APPLICATION IN THE ELLIOT LAKE AREA.
- 10-18 THE BOARD FINDS THAT THE PROCESS KNOWN AS "SOLIDIFICATION" HAS NOT UNDERGONE SUFFICIENT FIELD TRIAL TO DETERMINE ITS APPLICABILITY TO THE ELLIOT LAKE TAILINGS, ITS ABILITY TO WITHSTAND THE CLIMATIC EXTREMES, AND ITS ABILITY TO BE COMBINED WITH OTHER METHODS OF CONTOURING AND STABILIZATION AS PART OF A LONG TERM CLOSE-OUT PROCESS.
- 10-19 THE BOARD FINDS LITTLE EVIDENCE TO GIVE IT CONFIDENCE IN THE USE OF SYNTHETIC MEMBRANES, ASPHALT, CEMENT OR CHEMICAL MEANS TO COVER TAILINGS AREAS TO INHIBIT WATER INFILTRATION DURING THE LONG TERM.
- 10-20 THE BOARD RECOMMENDS THAT DENISON ACCELERATE ITS BACKFILLING PROGRAM TO PRODUCE RESULTS AND AN EVALUATION AS SOON AS POSSIBLE.
- 10-21 THE BOARD RECOMMENDS THAT THE MINISTRY OF NATURAL RESOURCES DEVELOP AN ABANDONMENT CRITERION WHICH WOULD OUTLINE WHEN A MINE OR A SECTION OF A MINE COULD BE CONSIDERED "MINED-OUT", FOR THE PURPOSE

OF USING PART OR ALL OF THAT MINED-OUT AREA FOR BACKFILLING.

- 10-22 THE BOARD RECOMMENDS THAT PRIORITY BE GIVEN TO THE STUDY OF BACKFILLING OVER DEEP LAKE DISPOSAL AS A WASTE MANAGEMENT OPTION.
- 10-23 THE BOARD RECOMMENDS THAT THE COMPANIES FUND A LARGE SCALE, IN SITU, STUDY OF AN APPROPRIATE SOLIDIFICATION PROCESS TO DETERMINE ITS APPLICABILITY AS A WASTE MANAGEMENT OPTION.
- 10-24 THE BOARD FINDS THAT TO ESTABLISH A VEGETATIVE COVER OF EITHER GRASSES OR LEGUMES HAS TAKEN AT LEAST FIVE YEARS OF ACTIVE CARE. STUDIES ARE PRESENTLY UNDERWAY TO DETERMINE WHETHER THE COVER WILL BE SELF-PERPETUATING.
- 10-25 THE BOARD RECOMMENDS THAT THE COMPANIES AND CANMET CONTINUE WITH THEIR VEGETATION STUDIES TO DEVELOP THE BEST SEED MIXTURE, APPLICATION RATES, AND LIMESTONE AND FERTILIZER ADDITIONS.
- 10-26 THE BOARD FINDS THAT THERE IS NOT SUFFICIENT INFORMATION ON THE DEPTH TO WHICH OXIDATION OF PYRITE OCCURS, THE LENGTH OF TIME OVER WHICH ACID WILL BE GENERATED OR THE QUANTITIES OF ACID THAT WILL BE GENERATED IN THE UPPER LAYERS OF THE TAILINGS.
- 10-27 THE BOARD RECOMMENDS THAT BOTH COMPANIES AND CANMET STUDY THE OXIDATION OF PYRITES IN TAILINGS TO DETERMINE THE DEPTH TO WHICH OXIDATION OCCURS AND TO ESTIMATE THE AMOUNT OF ACIDIC SEEPAGE THAT MAY BE GENERATED.
- 10-28 THE BOARD FINDS THAT THERE IS INADEQUATE INFORMATION TO EVALUATE RADIUM LEVELS IN SEEPAGE WATER FROM STABILIZED TAILINGS.
- 10-29 THE BOARD RECOMMENDS A JOINT STUDY BY THE COMPANIES AND CANMET OF THE EFFECTS OF VEGETATION ON RUNOFF, EVAPOTRANSPIRATION AND SEEPAGE. SUCH A STUDY SHOULD ALSO INCLUDE ANALYSES OF THE CONSTITUENTS OF SEEPAGE WATER INCLUDING TOTAL RADIUM. THE RESULTS OF PRESENT LABORATORY EFFORTS BY THE ENVIRONMENTAL PROTECTION SERVICE WOULD PROVIDE A USEFUL INPUT TO SUCH STUDIES.



2. RECOMMENDATIONS INVOLVING CURRENT TAILINGS OPERATIONS  
AND TAILINGS MANAGEMENT PROGRAMS  
(Chapter 10-1 to 10-15)

Tailings Lines (Chapter 10-1)

- 10-1 THE BOARD RECOMMENDS THAT THE MINISTRY OF THE ENVIRONMENT EVALUATE TAILINGS LINES, PUMPS AND VALVES WITH THE OBJECTIVE OF PREVENTING TAILINGS SPILLS IN NON-CONTROLLED AREAS. THIS EVALUATION SHOULD CONSIDER EMERGENCY SITUATIONS INCLUDING THE FAILURE OF TAILINGS LINES, PUMPS OR VALVES AND THE CONTROL OF THOSE SITUATIONS.

The responsibility lies with the companies for the prevention of tailings spills. The continuous evaluation of the situation, the preparation of a contingency plan for emergencies and regular reports to the Ministry of the Environment are deemed necessary. The AECB has advised that they will include these assessments in the licences of operation.

Bud Lake (Chapter 10-2)

- 10-2 THE BOARD RECOMMENDS THAT CONSTANT MONITORING BY THE MINISTRY OF THE ENVIRONMENT OF THE "WATER SEAL" AT THE WEST END OF THE BUD LAKE TAILINGS AREA TAKE PLACE DURING THE OPERATION LIFE OF THE TAILINGS AREA. THIS SEAL MUST BE IN PLACE CONTINUALLY TO ENSURE THAT ANY WATER FLOW IS TOWARDS BUD LAKE AND AWAY FROM DUNLOP LAKE.

Rio Algom Ltd. is responsible for the continued reliability of any containment structure. If the company receives approval to proceed with its proposed expansion of the Bud Lake Tailings Management Area, the "water seal" will be replaced by an impermeable dam by the company. If the impermeable dam is not built, then it is recommended that a continuous recorder and a differential water level monitor with an alarm back to the mill be installed.

Radium Precipitation (Chapter 10-3 to 10-4)

- 10-3 THE BOARD FINDS THAT THE EXPERIMENTAL TAILINGS EFFLUENT TREATMENT PLANTS OPERATED BY JAMES F. MACLAREN LIMITED ON BEHALF OF THE MINING COMPANIES AND BY THE WASTEWATER TECHNOLOGY CENTRE OF THE ENVIRONMENTAL PROTECTION SERVICE, ON BEHALF OF A NUMBER OF FEDERAL AGENCIES AND THE MINING COMPANIES, INVESTIGATING WAYS TO IMPROVE THE REMOVAL OF RADIUM ARE STILL AT THE POINT WHERE FURTHER EXPERIMENTATION AND REFINEMENT IS NEEDED.
- 10-4 THE BOARD RECOMMENDS THAT THE EXPERIMENTAL TAILINGS EFFLUENT TREATMENT PLANTS ESTABLISHED BOTH ON BEHALF OF THE COMPANIES AND BY THE

WASTEWATER TECHNOLOGY CENTRE OF THE ENVIRONMENTAL PROTECTION SERVICE, BE CONTINUED AND BE FUNDED BY THE COMPANIES AND FEDERAL AGENCIES UNTIL THE BEST PRACTICAL TECHNOLOGY IS DEVELOPED.

The Government is encouraged by the results achieved by the companies to date in the experimental effluent treatment plants. While radium levels in the Serpent River have improved generally, the need for continued vigilance during the expansion period is considered important enough to justify the continuation of this program by the companies and Federal Agencies.

The Ministry of the Environment will continue to review the reports submitted by the companies and the Federal Government and will request the implementation of those measures which would result in improved effluent quality. Radium-226 criteria will be incorporated into the AECB licence when the results of current research are evaluated.

#### Radium Redissolution

- 10-5 THE BOARD FINDS THAT THE POTENTIAL FOR REDISSOLUTION OF RADIUM FROM PRECIPITATION PONDS AFTER ABANDONMENT IS OF GREAT CONCERN.
- 10-6 THE BOARD RECOMMENDS THAT STUDIES BE INITIATED IMMEDIATELY BY THE COMPANIES INTO WAYS AND MEANS OF
- a) PREVENTING THE REDISSOLUTION OF RADIUM FROM THE PRECIPITATION PONDS AFTER CLOSE-OUT, AND
  - b) REMOVING THE PRECIPITATE TO A CONTROLLED AREA IF THIS SHOULD BE REQUIRED,
- AND FURTHER RECOMMENDS THAT THE PROVINCE AND THE AECB MONITOR THE PROGRESS OF SUCH STUDIES.
- 10-7 THE BOARD RECOMMENDS THAT THE COMPANIES IMMEDIATELY COMMENCE STUDIES TO DETERMINE THE EXTENT AND QUANTITY OF RADIUM DEPOSITED DOWNSTREAM FROM TAILINGS EFFLUENT DISCHARGES AND TO STUDY ITS IMPACT AND DETERMINE WAYS AND MEANS OF REMOVING THE DEPOSITS IF THIS SHOULD BE REQUIRED.

Despite improvements in radium levels in recent years, the Government continues to view the situation in the Serpent River with caution and considers that the two areas of investigation recommended by the Board will assist in providing more information on the quality of the water in the Serpent River Basin in the future.

The Government views the issues of radium redissolution (Chapter 10-6) and distribution of radium downstream from tailings areas as an integral part of the tailings management strategy (Chapter 10-39). The co-ordinating committee, as part of its terms of reference, will look at this matter as part of the overall tailings management strategy.

Tailings Dams (Chapter 10-8 to 10-11)

- 10-8 THE BOARD FINDS THAT THE MINISTRIES OF NATURAL RESOURCES, AND LABOUR, HAVE NO DEFINITIVE CRITERIA FOR EVALUATING THE CONSTRUCTION, MATERIALS USED, AND STABILITY OF TAILINGS DAMS.
- 10-9 THE BOARD FINDS THAT THE LONG TERM IMPERMEABILITY OF TAILINGS BASINS - SPECIFICALLY DAMS CONTAINING THE TAILINGS - CANNOT BE GUARANTEED.
- 10-10 THE BOARD RECOMMENDS THAT CRITERIA ON STRUCTURE, MATERIALS, STABILITY, AND SAFETY FACTORS BE DEVELOPED BY THE APPROPRIATE MINISTRIES INCLUDING NATURAL RESOURCES, AND LABOUR, TO GUIDE IN THE CONSTRUCTION OF THE DAMS PLANNED FOR TAILINGS CONTAINMENT IN THE ELLIOT LAKE AREA.
- 10-11 THE BOARD RECOMMENDS THAT THE PROVINCE AND THE ATOMIC ENERGY CONTROL BOARD CONSIDER A JOINT AND CONTINUING INSPECTION PROGRAM DURING DAM CONSTRUCTION.

Current criteria for the structure, materials, stability and safety factors for tailings containment are based on well-established engineering principles. In recognition that design procedures and the specification of absolute criteria pose difficulties to proponents, the Ministry of Labour has conducted a review of the state-of-the-art in tailings disposal technology. Tailings dam guidelines have been drafted relating to the pre-development design review, inspection procedures for the construction and operating phases of tailings dams and tailings-related structures, and the long-term auditing of their stability. The draft guidelines are being discussed with other Provincial and Federal Government Agencies following which the guidelines will be discussed with the mining industry.

In addition, regulations (Ontario Regulation 660/79) passed pursuant to The Occupational Health and Safety Act, give the Ministry of Labour the necessary regulatory powers to act on all the concerns expressed by the Board. Section 6 of the Regulations reads as follows:

- "6. A tailings dam or any other surface structure for the impoundment of tailings shall be,
  - (a) designed in accordance with good engineering practice by a professional engineer;
  - (b) constructed in accordance with the design; and

- (c) maintained so that the structure provides stability against any static and dynamic loading to which it may be subjected."

The regulations have been incorporated into federal legislation.

#### Coning and Stacking

- 10-12 THE BOARD FINDS THAT STACKING COULD BE AN APPROPRIATE METHOD TO MAXIMIZE THE CAPACITY OF TAILINGS BASINS.
- 10-13 THE BOARD RECOMMENDS THAT AN IMMEDIATE EVALUATION OF STACKING BE COMMENCED JOINTLY BY RIO ALGOM LIMITED, THE PROVINCE AND THE APPROPRIATE FEDERAL AGENCIES (AECB, CANMET) TO DETERMINE THE APPLICABILITY OF THIS METHOD TO THE ELLIOT LAKE AREA AND TO DEVELOP CRITERIA FOR CONSTRUCTION, MONITORING AND MAINTENANCE PROCEDURES.
- 10-14 THE BOARD FINDS THAT THE EXPERIMENTATION PROGRAM OUTLINED BY DENISON MINES LIMITED TO USE "THICKENED TAILINGS" TO FORM CONES OR DOMES ON THE WILLIAMS LAKE TAILINGS BASIN, IN ORDER TO ASSIST IN CONTOURING AND SURFACE DRAINAGE, IS A COMMENDABLE AND WORTHWHILE UNDERTAKING.
- 10-15 THE BOARD RECOMMENDS THAT DENISON MINES LIMITED AND RIO ALGOM LIMITED CO-OPERATE IN THE EXPERIMENTAL PROGRAM FOR THE DEVELOPMENT OF CONING THROUGH THE USE OF THICKENED TAILINGS.

The Government is advised that Rio Algom has prepared preliminary work on hypothetical models for stacking tailings. As the full investigation and analysis of the techniques must be related to site conditions, further work is required by the companies to prove the long-term stability of tailings deposited in this way. In January, 1980, Denison began a coning program at Williams Lake.

It is estimated that final results of these studies will be available in approximately five years. The Ministry of Labour and the Ministry of the Environment are reviewing these programs.

#### 4. WATER QUALITY

This section includes responses to the following:

- Water quality objectives
- Water quality parameters
- Quirke Lake treatment program
- Monitoring programs
- Water quality model

Water Quality Objectives (Chapter 11-2 to 11-4)

- 11-2 THE BOARD FINDS THE OBJECTIVE OF THE RESTORATION OF THE AQUATIC HABITAT IN THE SERPENT RIVER SYSTEM TO SUPPORT A VIABLE, SELF-SUSTAINING, HEALTHY AND WHOLESOME FISHERY TO BE APPROPRIATE.
- 11-3 THE BOARD FINDS THAT THE LEVELS ESTABLISHED FOR pH (6.0 OR ABOVE), AMMONIA (1.0 mg/l OR BELOW), AND TDS (500 mg/l OR BELOW) ARE NOT UNREASONABLE FOR THE RESTORATION OF A FISHERY ALTHOUGH SERIOUS ATTENTION MUST BE PAID TO RAISING THE pH 6.5 OR MORE, AND LOWERING THE AMMONIA BELOW 1.0 mg/l.
- 11-4 THE BOARD FINDS THAT THE LEVEL ESTABLISHED FOR RADIUM (3.0 pCi/l OR BELOW) IS RELATED TO PUBLIC HEALTH CONCERNS AND NOT TO THE RESTORATION OF A FISHERY.

The Government will continue to pursue aggressively its objective of restoring the aquatic habitat in the Serpent River system to support a viable, self-sustaining, healthy and wholesome fishery. The Ministry of the Environment's publication "Water Management" outlines the goals, policies, objectives and implementation procedures of the Government for managing the quality and quantity of the Province's surface and ground waters. Formally adopted for use in November, 1978, the publication was tabled at the Elliot Lake hearings on January 3, 1979.

The Ministry of the Environment is developing additional, more detailed procedures to implement the goals and policies of the "Water Management" document. Some of the procedures germane to the Elliot Lake situation which have been, or are being, developed, relate to such matters as mixing zones and the establishment of guidelines for the discharge of wastes containing radionuclides. Of these examples, the highest priority for Elliot Lake has been given to the definition of mixing zones, particularly for the Serpent River upstream of Quirke Lake where the quality of the water is most degraded. It is the Government's intention to impress on the AECB the importance of including these objectives in the operating licences. In addition, compliance with the water quality objectives outlined in "Water Management" will be regulated through Certificates of Approval and Control Orders issued by the Ministry of the Environment.

Water Quality Parameters (Chapters 11-5 and 11-6)

- 11-5 THE BOARD FINDS THAT BECAUSE PHOSPHOROUS LEVELS ARE LOW AND PHOSPHOROUS IS A LIMITED NUTRIENT, THE EVIDENCE DOES NOT SUPPORT THE CONTENTION THAT NITRATES IN THE SERPENT RIVER SYSTEM ARE PRESENTLY A PROBLEM. HOWEVER, THE BOARD IS CONCERNED WITH NITRATE LOADINGS THAT MIGHT REACH THE SERPENT HARBOUR AND AT SOME FUTURE DATE



BECAUSE OF PHOSPHOROUS ADDITIONS LEAD TO LOCAL EUTROPHICATION.

- 11-6 THE BOARD RECOMMENDS THAT THE PROVINCE DESIGN AND IMPLEMENT AN EXPERIMENT/STUDY TO DETERMINE WHETHER NITRATE LOADINGS IN THE ELLIOT LAKE AREA CAN LEAD TO EUTROPHICATION AND TO SEE WHETHER A NITRATE REDUCTION PROGRAM IN THE OPERATING MILLS IS NECESSARY. THE STUDY SHOULD ENDEAVOUR TO REACH A CONCLUSION WITHIN TWO YEARS.

The Government agrees with the Board's findings on phosphorous and notes its concern regarding the possible impact of nitrates downstream of the mills. Recognizing the usefulness of an experiment/study, the Ministry of the Environment has prepared terms of reference for such work and is carrying out the study.

Quirke Lake Treatment Program (Chapter 11-7)

- 11-7 THE BOARD RECOMMENDS THAT A TREATMENT PROGRAM BE DEVELOPED FOR QUIRKE LAKE BY THE MINING COMPANIES TO RAISE THE pH BY ADDITION OF LIME AND SODIUM OR CALCIUM CARBONATE. THE IMPLEMENTATION OF THE PROGRAM MUST BE CO-ORDINATED WITH AMMONIA REDUCTION PROGRAMS IN THE MINE/MILL FACILITIES AND CARE MUST BE TAKEN TO AVOID MOLECULAR AMMONIA TOXICITY.

As the EAB noted in 10-30, the mill tailings pose a great potential environmental impact. Considering this, the Government believes that all possible tailings disposal alternatives including "deep water disposal" should be examined as soon as possible. At the request of the Ontario Government, the AECB has asked the companies to study the environmental implications of utilizing Quirke Lake for tailings disposal. The terms of reference for the study are being formulated by the companies, the regulatory agencies and the U.S.W.A. This alternative must be found to be satisfactory during the operating and post operating phases and have advantages over the traditional "on land" basis before authorization to proceed will be given. The studies could take several years to complete.

For the above reason, the Government will withhold studies into the reclamation of Quirke Lake. If the studies into the utilization of Quirke Lake prove negative, the Government will assign staff from the Ministries of the Environment and Natural Resources to assist the mining companies in drawing up terms of reference for the treatment program and to monitor its progress. It is also suggested that such a program would benefit from co-ordination with the Government's Acid Precipitation in Ontario Study (APIOS).

Other relevant studies, either underway or proposed, should be incorporated into the program. These include a study by the companies' consultants on pH levels in Quirke Lake and the recommended experiment/study on nitrates (Recommendation 11-6).

Monitoring Program (Chapter 11-8 to 11-13)

- 11-8 THE BOARD RECOMMENDS THAT MONITORING OF HEAVY METALS BE CARRIED OUT BY THE COMPANIES AND THE PROVINCE TO DETERMINE THE EXISTING LEVELS, TRENDS AND WHETHER THE LEVELS COULD AFFECT THE GOAL OF ESTABLISHING A VIABLE FISHERY.
- 11-9 THE BOARD RECOMMENDS THE CONTINUATION OF THE WATER QUALITY MONITORING PROGRAMS OF DENISON, RIO, AND THE MINISTRY OF THE ENVIRONMENT. THE MINISTRY OF THE ENVIRONMENT SHOULD ENSURE THAT ITS PROGRAMS MONITOR AT LEAST THE SAME PARAMETERS AS THE COMPANIES ON A REGULAR BASIS SO THAT THE DATA MAY BE COMPARED TO THAT GATHERED BY THE COMPANIES.
- 11-10 THE BOARD RECOMMENDS THE ADDITION OF URANIUM, THORIUM-230, THORIUM-232 AND LEAD-210 TO THE QUARTERLY MONITORING PROGRAMS FOR AT LEAST FIVE YEARS AND THAT THEREAFTER THEY BE MONITORED ON A PERIODIC BASIS.
- 11-11 THE BOARD RECOMMENDS THE ADDITION OF TOTAL RADIUM TO THE WATER QUALITY MONITORING PROGRAMS.
- 11-12 THE BOARD RECOMMENDS THAT CAREFUL CONSIDERATION BE GIVEN BY THE PROVINCE AND THE AECB TO REQUIRING THE MONITORING OF EFFLUENTS FROM TAILINGS BASINS DURING THE POST-OPERATIONAL PERIOD - AT LEAST UNTIL TRENDS ARE ESTABLISHED.
- 11-13 THE BOARD RECOMMENDS THAT ALL DATA OBTAINED FROM THE WATER QUALITY MONITORING PROGRAMS OF THE COMPANIES AND THE PROVINCE BE EXCHANGED AND BE AVAILABLE TO THE PUBLIC.

In response to Recommendation 11-9, the Provincial Government monitors water quality in the Serpent River Basin on a routine basis and will continue to do so. In 1979, the Ministry of the Environment was responsible for stations at 36 locations, most of these stations being sampled at a frequency of ten times per annum for 21 chemical variables and dissolved Radium-226, gross alpha and beta activity. The Ministry of Natural Resources monitors fisheries, wildlife, forestry and recreation in the Serpent River system on a regular basis. In addition, the mining companies are responsible for collecting data from their own monitoring stations at selected sites both on and off their properties. The companies monitor the

same parameters as those measured at the Government's stations.

Comments on the other recommendations in this subsection are as follows:

11-8 HEAVY METALS ARE ALREADY MONITORED AND THE RESULTS OF THESE ANALYSES WILL BE REVIEWED IN CONJUNCTION WITH PROPOSED RECLAMATION PROGRAMS.

11-10 THORIUM 232 AND LEAD 210 ARE RELATIVELY INSIGNIFICANT WHEN COMPARED TO THE RADIUM DISCHARGES FROM THE MINING PROPERTIES. THE BENEFIT OF MONITORING THESE RADIOISOTOPES ON A QUARTERLY BASIS FROM EACH OF THE MINING PROPERTIES IS QUESTIONABLE. THE GOVERNMENT WILL CONDUCT THE TESTS ON AN ANNUAL BASIS TO MAKE CERTAIN A PROBLEM DOES NOT EXIST.

WITH RESPECT TO URANIUM, LEVELS ABOVE HEALTH AND WELFARE CANADA'S GUIDELINES FOR CANADIAN DRINKING WATER QUALITY 1978 HAVE BEEN FOUND AND HENCE QUARTERLY MONITORING OF URANIUM AT SELECTED SITES SHOULD CONTINUE.

11-11 IT IS AGREED THAT THE MANAGEMENT OF TOTAL RADIUM SHOULD BE ADDED TO THE WATER MONITORING PROGRAM AT ALL MONITORING STATIONS. THIS IS PARTICULARLY RELEVANT IN LIGHT OF THE PROPOSED NEW GUIDELINES FOR RADIUM IN DRINKING WATER IN WHICH LEVELS ARE BASED ON TOTAL RATHER THAN DISSOLVED RADIUM (SEE PAGE 19, RADIATION). A FURTHER POINT IN THIS REGARD IS THAT RADIUM WILL BE MEASURED AT POINTS OF EFFLUENT DISCHARGE AS THE MINISTRY OF THE ENVIRONMENT'S POLICIES DO NOT RECOGNIZE MIXING ZONES AS AN ALTERNATIVE TO THE TREATMENT OF EFFLUENT.

11-12 BECAUSE OF ITS CONCERN ABOUT POSSIBLE PROBLEMS FROM TAILINGS BASINS IN THE POST-OPERATIONAL PERIOD, THE GOVERNMENT AGREES WITH THE RECOMMENDATION TO MONITOR EFFLUENT FROM THESE AREAS UNTIL IT IS SATISFIED THAT THE TRENDS ESTABLISHED ARE SATISFACTORY.

11-13 WATER QUALITY DATA IS AVAILABLE AND WILL CONTINUE TO BE MADE AVAILABLE TO THE PUBLIC THROUGH THE WATER RESOURCES BRANCH, MINISTRY OF THE ENVIRONMENT. IN ADDITION, THE MINISTRY OF THE ENVIRONMENT WILL PREPARE AN ANNUAL REPORT ON WATER QUALITY IN THE SERPENT RIVER BASIN INCORPORATING THE MONITORING ACTIVITIES OF ALL THE AGENCIES THAT ARE INVOLVED. A REPORT ON 1980 WATER QUALITY MEASUREMENTS HAS BEEN RELEASED. REPORTS ON FISHERIES IN THE SYSTEM WILL BE PREPARED PERIODICALLY.



Dunlop Lake (Chapter 11-1)

- 11-1 THE BOARD RECOMMENDS THAT THE WATER LEVEL IN DUNLOP LAKE BE MONITORED CAREFULLY BY THE MINISTRIES OF NATURAL RESOURCES, AND ENVIRONMENT AND THAT A MINIMUM LEVEL OF THE LAKE BE ESTABLISHED, IN THE WATER TAKING PERMIT, BEYOND WHICH DRAW-DOWN SHOULD NOT OCCUR.

Dunlop Lake possesses healthy spawning beds for lake trout and is an important local recreation lake. The lake is also used by Rio Algom as a source of water for the Quirke Mill. The Government's aim is to ensure that the draw-down of water by the company does not interfere with spawning sites for lake trout and that opportunities for recreation are not hampered. The water level in the lake is monitored by Rio Algom as a condition of water-taking permits issued by the Ministry of the Environment.

The lack of winter readings has made it difficult to establish a precise draw-down limit. As a result, the Ministry of Natural Resources has established an interim limit of draw-down of 0.5 meters below the water level on October 1st for the critical trout egg incubation and hatching period between October 1st and April 1st. In addition.

- (a) the Ministry of Natural Resources is undertaking a survey of Dunlop Lake to determine the location of lake trout spawning areas and to determine more precisely the critical depth for the draw-down of water,
- (b) the Ministry of the Environment will establish a hydrological regime for the lake,
- (c) Rio Algom Ltd. has installed equipment to permit the water level to be monitored throughout the winter. In addition, those records are being supplied to the Ministry of the Environment on lake levels during the open water season.

Water Quality Model (Chapter 11-14 to 11-21)

- 11-14 THE BOARD FINDS THAT IT IS NECESSARY TO HAVE A MODEL CAPABLE OF MAKING REALISTIC PREDICTIONS OF WATER QUALITY IN THE LAKES OF THE SERPENT RIVER SYSTEM.

- 11-15 THE BOARD FINDS THAT THE MODEL USED BY THE COMPANIES HAS BEEN CALIBRATED FOR ONLY QUIRKE LAKE.
- 11-16 THE BOARD FINDS THAT THE CONFIDENCE LIMITS OF THE MODEL PREDICTIONS ARE DIFFICULT TO DETERMINE BUT GIVE THE CONSERVATIVE ASSUMPTIONS THE RESULTS CAN BE CONSIDERED REASONABLE FOR QUIRKE LAKE AND INDICATIVE OF TRENDS FOR DOWNSTREAM LAKES.
- 11-17 THE BOARD FINDS THAT THE MODEL COULD BE VERY USEFUL NOW AND IN THE FUTURE IN PREDICTING EFFECTS ON THE WATERSHED AS PLANS CHANGE OR DEVELOP.
- 11-18 THE BOARD RECOMMENDS THAT THE MODEL BE FULLY CALIBRATED FOR AT LEAST PECORS AND MAY LAKES AND VERIFIED FOR QUIRKE, PECORS AND MAY LAKES.
- 11-19 THE BOARD RECOMMENDS THAT THE COMPANIES ENSURE THAT THEIR MONITORING PROGRAMS ARE APPROPRIATE TO PROVIDE DATA FOR THIS CALIBRATION AND VERIFICATION.
- 11-20 THE BOARD RECOMMENDS THAT THE MODEL BE RERUN WITH THE EXPANSION PLANS AS THEY HAVE BEEN DEVELOPED USING UPDATED INFORMATION IN FLOWS, THE STANROCK MILL, AND OPERATIONAL LIFE OF ALL MILLS AND THAT THE RESULTS BE MADE AVAILABLE TO THE PROVINCE AND APPROPRIATE FEDERAL AGENCIES.
- 11-21 THE BOARD RECOMMENDS THAT THE MODEL BE USED TO STUDY ABANDONMENT PROGRAMS, USING INPUT FROM STUDIES OF WASTE MANAGEMENT AREAS AND OPTIONS, AS THEY BECOME AVAILABLE.

The Government agrees with findings 11-14 and 11-17. The Ministry of the Environment, in collaboration with the companies, has commenced a joint program to upgrade and revise the model in order to better predict downstream impacts.

The Government agrees with Recommendations 11-18 to 11-21 and will request that the companies use water monitoring data as they become available to calibrate the model for May, Hough and Pecors Lakes and then to validate the model for these lakes and for Quirke Lake. Radium 226 will be incorporated into the model and it should be re-run by the companies using updated information on their expansion plans and their abandonment programs.

## 5. AIR QUALITY

This section includes responses to the following:

- Air model
- Air monitoring
- Tailings exclusion areas

Air Model (Chapter 12-1 and 12-6)

- 12-1 THE BOARD FINDS THAT LIMITATIONS ON THE STATE OF THE ART FOR MODELLING RADON AND PARTICULATE DISTRIBUTION FROM TAILINGS AREAS MUST BE RECOGNIZED AND THEREFORE TO BETTER DEVELOP THE MODEL, A POOLING OF RESOURCES BETWEEN THE PROVINCE AND THE PROPONENT IN THIS SITUATION WOULD BE APPROPRIATE. IF THE PROVINCE FINDS INSUFFICIENT EXPERTISE ON STAFF TO EVALUATE THE APPROACH AND DETAILS OF THIS OR OTHER SIMILAR SITUATIONS, SERIOUS CONSIDERATION SHOULD BE GIVEN TO USING AN INDEPENDENT CONSULTANT TO ADVISE THE PROVINCE.
- 12-6 THE BOARD RECOMMENDS THAT THE METEOROLOGICAL STATION AT THE ELLIOT LAKE AIRPORT BE USED TO COLLECT CONTINUING DATA FOR USE IN THE AIR QUALITY MODEL AND TO PROVIDE A CORRELATION WITH SUDBURY DATA USED FOR PAST PREDICTIONS.

At the present time, the development of a model or models is not considered necessary. Instead, the Government is conducting an ambient air sampling program which is providing data on ambient air parameters including radon daughter concentrations. Further samplings will be undertaken as the need arises.

Meteorological data are absolutely vital; they are needed to interpret present and future ambient air measurements, whether or not a tailings model is developed. Wind speed and direction data should be obtained on a continuous basis. The Ministry of the Environment will assume the responsibility for the cost and operation of the station.

Air Monitoring (Chapter 12-2 to 12-5 and 12-7)

- 12-2 THE BOARD RECOMMENDS THAT THE PROVINCE PROCEED WITH A MONITORING PROGRAM TO MEASURE THE AMBIENT RADON AND RADON DAUGHTER LEVELS AT TAILINGS AREAS AND TOWNSITES.
- 12-3 THE BOARD RECOMMENDS THAT THE COMPANIES IN CO-OPERATION WITH CANMET STUDY THE VARIABLES WHICH AFFECT THE EMANATION RATE OF RADON FROM VEGETATED AND NON-VEGETATED TAILINGS.
- 12-4 THE BOARD RECOMMENDS THAT AN INTENSIVE CONTINUING MONITORING PROGRAM FOR SUSPENDED PARTICULATE AND DUSTFALL BE UNDERTAKEN BY THE MINISTRY OF THE ENVIRONMENT AND THE COMPANIES TO IDENTIFY ANY AREAS OF CONCERN IN THE RESIDENTIAL AREAS IN THE

ELLIOT LAKE AREA. THIS PROGRAM SHOULD PARTICULARLY ENSURE THAT THE RESIDENCES WITHIN 2 km. OF THE TAILINGS AREAS RECEIVE COMPREHENSIVE MONITORING.

- 12-5 THE BOARD RECOMMENDS THAT ANALYSES FOR LEAD-210 BE INCLUDED IN THE AIR QUALITY MONITORING PROGRAM.
- 12-7 THE BOARD RECOMMENDS THAT ALL DATA OBTAINED FROM THE AIR QUALITY MONITORING PROGRAMS OF THE COMPANIES AND THE PROVINCE BE EXCHANGED AND BE AVAILABLE TO THE PUBLIC.

Chapter 12-2: This recommendation is being implemented.

- 12-3: A study of radon emanation rates should be integrated with other elements of research involving the tailings management program. Since both the type of surface covering and size of material affect the rate of radon emanation from uranium mine tailings, CANMET believes that a study of these variables would be productive and intends to pursue this matter during 1982.
- 12-4: The Ministry of the Environment will continue its current particulate monitoring program, with specific regard given to the Board's recommendation in residences within 2 km of the tailings areas.
- 12-5: The Ministry of the Environment has undertaken a preliminary study of Pb-210 levels and found them to be generally low. Periodic monitoring of Lead 210 will take place.
- 12-7: The continuous exchange of data between the companies and the Government will be arranged and incorporated into an annual report to be published by the Government on air quality in the Elliot Lake area.

Tailings Exclusion Areas (Chapter 13-11 to 13-14)

- 13-11 THE BOARD RECOMMENDS THAT FURTHER DEVELOPMENT OF RESIDENCES WITHIN 2 KILOMETERS OF TAILINGS AREAS NOT BE PERMITTED.
- 13-12 THE BOARD RECOMMENDS CAREFUL ANALYSIS BY THE PROVINCE OF THE RESULTS OF AIR MONITORING PROGRAMS CARRIED OUT AT THE RESIDENCES OR TOWN-SITES WITHIN 2 KILOMETERS OF TAILINGS AREAS, TO DETERMINE WHETHER OR NOT THERE IS ANY CONCERN FOR THE HEALTH OF INDIVIDUALS WHO RESIDE THERE.

- 13-13 THE BOARD RECOMMENDS THAT IF MONITORED LEVELS AT ANY RESIDENCES CONSISTENTLY EXCEED CRITERIA, AND THESE LEVELS CANNOT BE REDUCED, SERIOUS CONSIDERATION BE GIVEN TO RELOCATING THE RESIDENCES SO AFFECTED.
- 13-14 THE BOARD RECOMMENDS THAT THE RESULTS OF MONITORING PROGRAMS CARRIED OUT ON OR NEAR TAILINGS AREAS BE USED BY THE AECB AND THE PROVINCE TO ASSESS THE POTENTIAL LONG TERM USE OF THE TAILINGS AREAS.

Present data on radon emanation rates from tailings and downwind dispersion of this radon indicate that it is not necessary to establish a building exclusion zone extending 2 km from each tailings area. Appropriate dimensions for an exclusion zone would vary for each tailings area. The determination of such dimensions would involve the measurement of many parameters, e.g., concentrations of radionuclides in air and groundwater and local meteorological conditions, at different points around the tailings. This would involve a considerable investment of resources and manpower, with limited benefits, since most areas near tailings are not being considered for residential development.

The Government is therefore pursuing a more direct approach to the problem of deciding whether or not an area should be developed for housing. This involves monitoring to measure airborne radionuclides, and ambient radon and radon daughter concentrations, as well as an investigation of local meteorological conditions. This sampling will continue over a period of a year at each location where development has been proposed. This monitoring is presently undertaken by the Ministry of Labour and the Ministry of the Environment.

Homes located in residential areas on the property of the mining companies and outside the subdivisions in the Town are subject to the licencing procedures of the AECB and are therefore subject to its criterion of 0.02 WL for houses. Residences at the companies' housing areas have been monitored and the results supplied to the AECB. No problems have been identified to date.

This new monitoring regime could lead to delays in the approval of proposed developments and the extra time required should be taken into consideration by developers and the Town.

## 6. RADIATION

This section includes responses to the following:

- Radium uptake in plants
- Effects of radium on man
- Radium standards and criteria
- Standard setting procedures
- The ALARA principle and its application
- Radon in homes

Radium Uptake in Plants (Chapter 13-1 to 13-2)

- 13-1 THE BOARD FINDS THAT THE EVIDENCE PRESENTED ON RADIUM UPTAKE IN PLANTS INDICATED THAT THERE IS SOME CONCENTRATION OF THIS RADIONUCLIDE IN PLANT TISSUES.
- 13-2 THE BOARD RECOMMENDS THAT A STUDY PROGRAM INTO BOTH THE UPTAKE OF RADIONUCLIDES IN PLANTS AND THE POTENTIAL FOR FURTHER MOVEMENT THROUGH THE FOOD CHAIN BE INITIATED AND COMPLETED JOINTLY BY THE MINING COMPANIES AND CANMET.

The co-ordinating committee will investigate means to ensure that mining companies integrate the monitoring of radium uptake in plants into their proposed vegetation program for the tailings areas. In addition, the Government of Ontario has commissioned Laurentian University to undertake a study of uranium and other elements in mosses growing in the Elliot Lake area. CANMET has initiated studies on the pathways to radionuclide uptake.

Effects of Radium on Man (Chapter 13-3)

- 13-3 THE BOARD FINDS THAT THE CONTENTION THAT A LARGE PERCENTAGE OF THE POPULATION IS IMMUNE TO RADIATION INDUCED CANCERS IS NOT SUPPORTED BY THE EVIDENCE PRESENTED TO THE BOARD.

The Government concurs with the finding.

Radium Standards and Criteria (Chapter 13-4 to 13-6)

- 13-4 THE BOARD FINDS THAT THERE ARE DIFFERENT FEDERAL AND PROVINCE OF ONTARIO STANDARDS FOR RADIUM IN WATER WHICH ARE MEASURED IN DIFFERENT WAYS. HOWEVER, TO THE LAY-PERSON THE DIFFERENCE WITH RESPECT TO MEASURING TECHNIQUES IS NOT APPARENT. FOR THE ELLIOT LAKE AREA, THE EVIDENCE, ALTHOUGH PRELIMINARY, INDICATES THAT THE TWO MEASURING TECHNIQUES MAKE NO SIGNIFICANT DIFFERENCE IN THE NUMERICAL RESULTS.
- 13-5 THE BOARD FINDS THAT IT IS CONFUSING AND INAPPROPRIATE TO HAVE TWO STANDARDS BEING APPLIED IN THE ELLIOT LAKE AREA WITH RESPECT TO RADIUM IN WATER.
- 13-6 THE BOARD FINDS THAT A FEDERAL/PROVINCIAL TASK FORCE IS PRESENTLY EVALUATING THE RADIUM STANDARD FOR DRINKING WATER. GIVEN THIS EVALUATION, THE



BOARD IS ONLY PREPARED TO RECOMMEND THAT THERE BE ONE STANDARD FEDERALLY AND PROVINCIALY (IN ONTARIO) AND THAT THIS STANDARD REFER TO TOTAL RADIUM.

Guidelines for radionuclides in drinking water have been established by a Federal/Provincial Task Force and have been published in the "Guidelines for Canadian Drinking Water Quality, 1978" and in the "Revised Ontario Drinking Water Objectives, 1981". The Ontario and Federal Governments have agreed to adopt the same guidelines for total radium in water.

Standard Setting Procedures (Chapter 13-7 and 13-8)

- 13-7 THE BOARD FINDS THAT SEVERAL TIMES DURING THE HEARING CRITICISMS WERE RAISED ABOUT THE WAY IN WHICH STANDARDS ARE SET. THE BOARD IS OF THE OPINION THAT THE PUBLIC INPUT (INCLUDING THAT OF INTEREST GROUPS SUCH AS UNIONS, COMPANIES) SHOULD BE CONSIDERED BEFORE STANDARDS SUCH AS THOSE FOR RADIUM-226 IN DRINKING WATER ARE IMPOSED. THE BOARD NOTES THAT PUBLIC INPUT WAS REQUESTED AND RECEIVED BY THE PROVINCE IN THE SPECIAL SETTING ON RADON WHICH INCLUDED A STANDARD FOR RADON IN HOMES - HELD IN MARCH, 1978.
- 13-8 THE BOARD RECOMMENDS THAT WHEN ANY STANDARDS FOR RADIONUCLIDES ARE IMPOSED, THERE BE A CLEAR INDICATION BY THE BODY SETTING THE STANDARDS OF THE REASONS FOR CHOOSING THE PARTICULAR STANDARD AND THAT THESE REASONS BE AVAILABLE FOR THOSE WHO ARE, OR MAY BE, AFFECTED BY THE STANDARD.

In the Board's final report, reference was made in Chapter 13 to the need for public input before standards or criteria are imposed. Such a process is already in place in the Ministry of Labour with regard to occupational health and safety standards. The Ministry of the Environment will undertake an evaluation of alternative approaches in this regard.

The ALARA Principle and Its Application (Chapter 13-9 and 13-10)

- 13-9 THE BOARD RECOMMENDS THAT THE ALARA PRINCIPLE (AS LOW AS REASONABLY ACHIEVABLE, ECONOMIC AND SOCIAL FACTORS BEING TAKEN INTO ACCOUNT) SHOULD APPLY TO ALL RADIONUCLIDES BEING RELEASED TO THE ENVIRONMENT IN ELLIOT LAKE AREA.
- 13-10 BASED ON THE EVIDENCE OF ALL THE EXPERTS HEARD ON THE SUBJECT OF RADIOACTIVITY, THE BOARD FINDS THAT IF THE EXISTING STANDARDS/CRITERIA FOR RADON

AND RADIUM ARE APPLIED TOGETHER WITH THE ALARA PRINCIPLE, THE PEOPLE OF THE ELLIOT LAKE AREA CAN BE CONFIDENT THAT THE EXPANSION WILL NOT RESULT IN ANY UNACCEPTABLE RADIOLOGICAL EXPOSURE. THE BOARD IS AWARE THAT CERTAIN STANDARDS/CRITERIA, SPECIFICALLY FOR RADIUM, ARE PRESENTLY UNDER REVIEW. THE BOARD DOES NOT MAKE ANY COMMENT ON WHAT SUCH NEW STANDARD/CRITERION SHOULD BE.

The Government concurs.

#### Radon in Homes

This section arises from the conclusions of the Environmental Assessment Report published in May 1978 following a special hearing on criteria and approval procedures governing naturally occurring radiation in new construction at Elliot Lake. The Environmental Assessment Board considered presentations and conclusions based on: proposed criteria for radioactivity in new construction, an evaluation of health risk at the criterion level, a discussion of the design of buildings to minimize the penetration of radon gas and measures to control radon gas in new construction. The Board concluded that the approach proposed by the Ontario Government was generally acceptable.

Unofficially since 1977 and by Regulation of the Ontario Building Code since August 1978, all new construction in Elliot Lake has been required to meet a performance standard, in respect to radon, as a condition of occupancy. In addition the Federal-Provincial Task Force on Radioactivity with financial support by the Province of Ontario is nearing completion of the program to bring interior levels of radon in existing buildings into compliance with the criterion. This standard requires that the annual average concentration of radon 222 shall not exceed 7 picocuries per litre of air and the annual average concentration of the short-lived daughters of radon 222 shall not exceed 0.02 Working Levels inside the building.

At present, the Ministry of Labour provides the radon testing service to the Town of Elliot Lake.

A variety of techniques have been used to control interior levels of radon and new ones are still being developed. The objective is to find alternative methods which will be economical, minimize maintenance over the long-term and which will be least subject to interference by the occupants. The Ministry of Municipal Affairs and Housing has initiated a collaborative design project for controlling radon for installation and evaluation in new houses during the 1981 construction season with the two Elliot Lake mining companies, Ontario Hydro and the relevant Provincial Ministries.



There has not yet been enough elapsed time to complete the evaluation of these techniques or to formulate an ongoing community radiation protection program. The Government will continue to assume this responsibility until a permanent program and administration can be established.

#### 7. GENERAL MATTERS

In the final part of its report, the Environmental Assessment Board included considerations which did not fit into any of the other sections. The Government has comments with respect to the Serpent River Indian Band and the availability of borrow material.

##### Serpent River Band

The Department of Indian and Northern Affairs, as the agency responsible for dealing with the affairs of the Band and its lands, were provided with a copy of the Board's report. In addition, the Chief of the Band and his representatives met with the Premier and two of his Ministers in October, 1979 to make known their views about the Board's report. These were subsequently relayed to the Department for Indian and Northern Affairs. The prime concerns of the Band at the meeting were the need for more detailed information about further action on pollution from an abandoned acid plant at Cutler and the lack of consistency between Federal and Provincial standards governing Radium 226 in drinking water.

With regard to the abandoned acid plant, a study of the problem by the University of Toronto was commissioned by the Department of Indian and Northern Affairs in 1979. The study, which includes rehabilitation options and costs, has been completed and will be evaluated.

##### Availability of Borrow Material

This issue was not raised in the EAB hearings. However, subsequent to the hearings, the Town, the United Steel Workers of America and the companies have expressed their concerns about the availability of supplies of borrow material sufficient to meet the anticipated demand.

The Ministry of Natural Resources undertook an aggregate resource study in the Elliot Lake area in 1981.

#### 8. CO-ORDINATION OF ACTIVITIES AND PRIORITIES

The Board's report drew attention to the need for all agencies involved in Elliot Lake to work together on the management and the protection of the environment. The Government recognizes the difficulties involved in maintaining liaison among these agencies and is prepared

to establish a comprehensive management program to capitalize on the advantages to be derived from co-operative action.

As an important first step in this program, the Government will establish a co-ordinating committee to assist in the clarification of functions and roles, to oversee the research and monitoring activities of agencies and to expedite the processing and review of proposals arising from the expansion, operation and eventual decommissioning of the mines.

The Government also intends to continue its efforts to clarify the regulatory and administrative functions of Provincial agencies in relation to the Atomic Energy Control Board and other Federal agencies. In the introduction, reference was made to the confusion arising from the lack of a clear definition of responsibility and the limited scope of general conditions applied by the AECB in operating licences granted to the mines.

For the present, the Ontario Government recognizes the importance of the AECB licence as an effective tool in the development and maintenance of an environmental management program for Elliot Lake. The AECB has agreed in principle to reviewing its licencing procedures as they affect the mining industry so that such matters as Provincial water quality objectives, tailings storage techniques and other matters of concern raised in this report can be incorporated in the AECB's operating licences for the mines at Elliot Lake.

A further aspect of the management program will be the establishment of long term objectives for the Elliot Lake area. In this respect, the Government is aware that substantial progress has been made to protect the environment and is intent on ensuring that further improvements are carried out as the expansion and operation of the mines proceed.

To begin the process of establishing objectives, the co-ordinating committee will be instructed to pursue the following issues in consultation with the appropriate agencies:

- to initiate steps aimed at developing a rehabilitation strategy for the Serpent River system, including the necessary reduction of ammonia in the effluents from the mining/milling operations
- a reduction in the quantity of fresh water used in the mines and the mills,

- participation in the development and implementation of a long term tailings management strategy for Elliot Lake in consultation with the mining companies and Federal Government agencies. As an immediate step, the Government will ensure the co-ordinating committee pursues the following objectives:
  - . the adoption of goals and objectives proposed by the Environmental Assessment Board as the basis of environmental management and planning of tailings areas,
  - . the establishment of priorities for research and monitoring among the various agencies involved,
  - . the development and implementation of comprehensive operational plans for the management of tailings areas,
  - . an investigation into the establishment of an appropriate fund or funds to guarantee the stability and long term maintenance of tailings areas;
- to establish a meteorological monitoring program for the Elliot Lake area and to continue the investigation of ambient air quality in relation to existing and proposed developments,
- liaison with the Public Information Committee and the publication of progress reports or reports on issues.

Finally, the Government is committed to ensuring that the Board's work of drawing together the many aspects of the uranium mine/mill process and its effect on the Elliot Lake environment is translated into sound environmental practice by the companies as well as the Government agencies. Co-operative action is a necessary prerequisite to future improvements.

APPENDIX A  
ONTARIO GOVERNMENT INVOLVEMENT  
AT  
ELLIOT LAKE

## ONTARIO GOVERNMENT INVOLVEMENT AT ELLIOT LAKE

There are three ministries involved in administering provincial legislation, monitoring and auditing the activities of the mining companies at Elliot Lake; Environment, Labour and Natural Resources. The following are the activities of those ministries involved in mining, milling, tailings management and environmental matters.

### Mining and Milling

The activities of the companies in the mines and the mills are subject to inspection or audit by the Mining Health and Safety Branch, Ministry of Labour. The Ministry operates within the ambit of The Atomic Energy Control Act for matters involving radioactivity and pursuant to the Canada Labour Code, Part IV, for "conventional" health and safety matters. Part IV of the Canada Labour Code incorporates the Occupational Health and Safety Act, 1978 and Regulations for Mines and Mining Plants.

In addition to this, the Ministry of the Environment's district office receives information on a monthly basis relating to the amount of ammonia and nitrates in the mine waters being pumped from Rio Algom's Quirke and Panel Mines and Denison's Denison Mine. These data will continue to be accumulated and periodically reviewed to ascertain if improvements are being made in the handling of explosives. The Ministry of Labour will be informed of these results. The companies also submit information regularly to the Ministry of the Environment on daily water consumption in the mills.

The Ministry of Natural Resources' involvement is related primarily to its responsibilities towards the province's mineral resources. The Ministry monitors ore reserves, production costs and the impact of Government action on the economic stability of the mines and levies the mining tax on the mines. In addition, the Ministry attempts to ensure that whatever actions taken by the companies or Government agencies will not jeopardize the future mining potential in the area.

### Tailings Management

The placement of tailings in each of the active tailings areas is monitored by the Ministry of the Environment on a quarterly basis. This is usually carried out when the Ministry's environmental officers collect effluent quality samples as part of their auditing function.

The Ministry of Labour is involved in the design, construction and maintenance of tailings dams under The

Occupational Health and Safety Act, 1978 and Regulations for Mines and Mining Plants.

The Ministry of Natural Resources monitors tailings areas from the standpoint of the use of Crown Land and the construction of dams in a water course. The Ministry is also concerned about the quality of effluents from tailings management areas and their effect on the resources for which the Ministry is responsible.

#### Water Quality

The Ministry of the Environment currently monitors 21 stations in the Serpent River Basin at a frequency of 10 times per annum and 15 other stations, accessible only by air, twice a year. Samples are analyzed in the Ministry's laboratories for 14 parameters. Minor modifications are necessary to this program to account for the recommendations of the Environmental Assessment Board. The Ministry of Natural Resources works closely with the Ministry of the Environment in assessing the effect of the water quality on wildlife, fisheries, forests and recreation in the Serpent River Basin.

The Ministry of the Environment will prepare annual reports on water quality in the Serpent River Basin. These reports will also describe progress in the implementation of the rehabilitation programs proposed by the Environmental Assessment Board. A report on the 1980 water quality has been released.

#### Air Quality

The Ministry of the Environment operates 4 high volume stations and 10 dustfall stations to measure airborne particulates. In addition, the Radiation Protection Service, Ministry of Labour, has undertaken an air monitoring program at four outdoor sites near tailings areas and indoors in bunkhouses and trailers near tailings areas. The Radiation Protection Service also measures radon daughter concentrations in new homes built in Elliot Lake.

The results of outside air quality measurements will be incorporated into an annual report. The results of test measurements of radon daughters in new homes are submitted to the Town of Elliot Lake.

The activities of the Ontario Government will be coordinated with those of other Government Agencies and the companies.





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